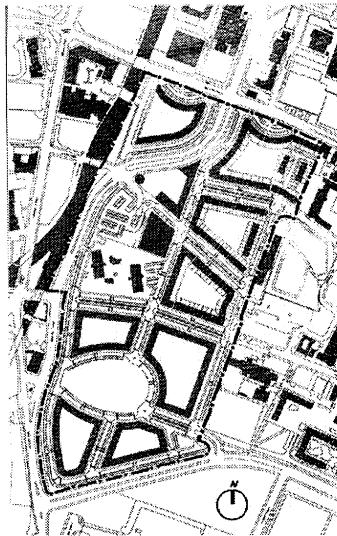


STREET DESIGN AND ACCESS CONTROL

Technical Design Manual #4



Chandler • Arizona

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**TECHNICAL DESIGN MANUAL NUMBER 4
CHANDLER POLICIES AND GUIDELINES FOR
STREET DESIGN AND ACCESS CONTROL**

TABLE OF CONTENTS

	<i>Page</i>
I. Policy	1
II. Definitions	2
III. Design Standards	4
3.1 General Considerations	4
3.2 Standard Specifications and Details	4
3.3 Horizontal Alignment	5
3.4 Vertical Alignment	9
3.5 Raised Barrier Median Design	9
3.6 Miscellaneous Geometric Standard	9
3.7 Deceleration Lanes and Bus Bays Design	14
3.8 Bus Bays or Pullouts, Bus Stops and Bus Shelter	17
3.9 Drainage Structures	18
3.10 Arterial Street Lane Widths	19
IV. Pavement Structural Design Standards	20
4.1 Flexible Pavement	20
4.2 Rigid Pavement	20
4.3 Decorative Pavement	20
4.4 Miscellaneous Pavement Standards	20
V. Miscellaneous Street Standards	21
5.1 Traffic Control Devices and Street Name Signs	21
5.2 Partial Street and Half-Street Standards	23
5.3 Phasing Requirements	25
5.4 Private Streets	25
5.5 Streetlights	25
5.6 Traffic Calming Devices	25
VI. Plan Requirements	26
VII. Access Control Policies and Guidelines	27
7.1 General Considerations	27
7.2 Definitions	28
7.3 Access Locations Along Arterial Streets	28
7.4 Planning and Design for Intersections	30
7.5 Access Driveway Location	32
7.6 Access Driveway Design	33

LIST OF TABLES

	<u>Page</u>
Table 1 - Subgrade Compaction Requirements for Curbs, Gutters, and Sidewalks	5
Table 2 - Summary of Design Standards	6
Table 3 - Horizontal Alignment Taper Requirements	7
Table 4 - Minimum Curb Return Radii Requirements	10
Table 5 - Minimum Width Requirements for Private Streets	25
Table 6 - Minimum Stopping Sight Distances	31
Table 7 - Recommended Driveway Dimensions Along Arterial and Collector Streets	33

LIST OF FIGURES

	<u>Page</u>
Figure 1 - Bubbles for Streets	8
Figure 2 - Design Aid for Major Intersection Cross-section	11
Figure 3 - Median Bullnose Location at Intersection	12
Figure 4 - Median Bullnose at Driveway Entrance	13
Figure 5 - Area Triangle	15
Figure 6 - Minimum Turning Radii	16
Figure 11 - Railroad Markings	22
Figure 12 - Driveway Spacing Along Arterial and Collector Streets	35

SECTION I

I. POLICY

All streets within, and adjacent to developments shall be improved to City Standards. The developer is responsible for all costs associated with the required improvements.

Functional classifications for principal arterials and major or minor arterial streets are contained in the City's currently effective Transportation Plan. Functional classifications for other streets shall be determined by the Public Works Director or his designee. Minimum required rights-of-way widths shall be in accordance with the City Code.

A traffic analysis by a traffic consultant is required for proposed developments determined by the Public Works Director or his designee to have a large impact on the street system. The required elements of the traffic analysis are contained in the Policy on Traffic Impact Assessments for Project Development (Section 7.1.2). The developer is responsible for the costs of the analysis as well as the costs for implementing the recommendations of the analysis.

SECTION II

II. DEFINITIONS

For the purposes of this manual, the following definitions are used:

Alley: A public thoroughfare that affords only a secondary means of access to abutting property.

- (a) Major alley: Serves multifamily residential, commercial, and industrial areas.
- (b) Minor alley: Serves single-family residential areas.

Developer: The individual, firm, corporation, partnership, association, syndicate, trust, or other legal entity that files the application and initiates proceedings for the development and/or subdivision of land in accordance with the City Code and said developer need not be the owner of record of said land.

Easement: A grant by the owner for the use of specified land by the public, a corporation, or persons, for specific uses and purposes and so designated and recorded in the county recorder's office.

Median: A raised or flush area designed to separate and control vehicular movement.

Pedestrian Way: A public walk dedicated entirely through a block from street to street and/or providing access to a school, park, recreation area or shopping center.

Right-of-Way: Any land which by deed, conveyance, agreement, easement, dedication, usage, zoning condition, process of law or other means is reserved for or dedicated to the general public for street, highway, alley, public utility, or pedestrian walkway purposes and accepted by the City.

Street: Any existing or proposed street, avenue, boulevard, road, bridge, viaduct, or easement for public vehicular access or a street shown in a plat duly filed and recorded in the county recorder's office. A street includes all land within the street right-of-way whether improved or unimproved and includes such improvements as pavement, shoulders, curbs, gutters, sidewalks, parking spaces, bridges, viaducts and traffic-control devices.

- 1) Agrarian street: A street typically located within an agricultural, AG-1 zoning, or large lot residential district.
- 2) Arterial street: A major street of exceptional continuity that is intended to carry the greater portion of through traffic from one area of the City to another and is generally positioned at one mile intervals. Major and minor arterials are designated in the current City Transportation Plan.
- 3) Collector street: A street designed with the primary purpose of collecting and distributing traffic, to and from, arterial streets.

- a) Industrial collector: A collector street serving commercial, industrial or other land uses expected to generate high traffic volumes or substantial heavy truck traffic.
- b) Residential collector: A collector street serving predominantly residential land uses.
- 4) Local street: Typically, a street of limited continuity with the primary purpose of serving only those lots, which are adjacent.
- 5) Cul-de-sac: A short local street having but one end open for vehicular traffic, the opposite end being terminated with a permanent turnaround.
- 6) Private street: A street not owned or maintained by the City.
- 7) Public street: A street owned and maintained by the City.
- 8) Driveways:
 - a) Commercial driveway: Access for retail, office, high density residential or government/community service building.
 - b) Industrial driveway: Access for large industrial, office park, mixed use, or warehouse developments which may also accommodate heavy truck movements.
 - c) Residential driveway: Access to single family residence from local or collector street only. Access from an arterial street is not allowed in the city.
 - d) Parking lot access way: Access to and circulation among parking areas within an integral apartment or townhouse complex.

SECTION III

III. DESIGN STANDARDS

3.1 General Considerations

The design standards presented within this manual should be treated as minimum standards. The American Association of State Highway and Transportation Officials (AASHTO) has published several design standard policies. Should a conflict between this manual and an AASHTO policy occur, the City's standards or policies shall apply.

All traffic control signs and pavement markings shall be in accordance with the Manual on Uniform Traffic Control Devices (MUTCD) prepared by the U.S. Department of Transportation and the City of Chandler's Standard Details. All traffic control materials used shall conform to Arizona Department of Transportation Standard Drawings and Specifications (ADOT) unless otherwise noted.

The City Engineer may promulgate additions or revisions to the standards as needs arise.

3.2 Standard Specifications and Details

The City has adopted Maricopa Association of Governments (MAG) Standard Specifications and Standard Details. Several of those have been modified, as shown in the City's Standard Details and Specifications. MAG specifications and details shall be used except where corresponding specifications or details have been adopted by the City.

Sub-grade relative compaction requirements for curbs, gutters and sidewalks are presented in Table 1. These shall be used in place of Section 301.3 of the MAG Standard Specifications.

TABLE 1

**SUBGRADE COMPACTION REQUIREMENTS FOR CURBS, GUTTERS,
AND SIDEWALKS**

<u>SWELL, %</u>	<u>COMPACTION, %</u>
0 to 1.5	Minimum of 85
Greater than 1.5	Minimum of 80, Maximum of 90

Note: The swell percentage is determined by placing a sample compacted, remolded, at 2 to 3 percent below the optimum moisture content, Standard Proctor Test, in a consolodometer apparatus and applying a 100 psf surcharge. The sample is then saturated and swell values are determined.

Right-of-way width and required improvements for each street classification are found in the City Standard Details. Newly constructed and reconstructed arterial streets are to be designed to accommodate on-street bike lanes, except where the necessary street width is not feasible because of right-of-way or existing development constraints. Bike lanes are to be marked on collector streets selected by City staff in consultation with the developer or neighborhood representatives.

A brief summary of the City's design standards is shown in Table 2. Each of the design standards is discussed in greater detail in the following sections.

3.3 Horizontal Alignment

The minimum horizontal centerline radii shown in Table 2 are for normally crowned streets. The use of super-elevation to reduce the minimum horizontal centerline radii is prohibited on all streets except arterials. Super-elevation may be used on arterial streets upon approval of the Public Works Director or his designee, providing the street cross-slope does not exceed 4.0%. The City reserves the right to modify the design speeds shown in Table 2 for arterial and collector streets when justified by special circumstances where overall safety is not compromised.

For special cases where the minimum tangent lengths shown in Table 2 cannot be achieved, the Public Works Director or his designee may approve reduced requirements providing that sight distance and overall safety are not compromised. In general, intersection tangents will not be required where the radii for both streets are 400 feet or greater.

All street intersections with arterials or major collectors shall be at 90 degrees. All other street intersections shall not vary from 90 degrees by more than ± 15 degrees.

Horizontal curves are not required when the necessary alignment change can be accomplished with a taper. Taper requirements are given in Table 3. Please note that these taper requirements also apply when narrowing the improved street width, and may apply to widened sections if traffic lanes are being offset.

TABLE 2
SUMMARY OF DESIGN STANDARDS
STREET TYPE

ITEM	MAJOR & MINOR ARTERIAL	COLLECTOR	LOCAL
Design Speed (mph)	55	40	25
Minimum Horizontal Centerline Radius (ft)	1,800	700 (with driveways) 400 minimum (no driveways)	250 (with driveways) 150 minimum (no driveways)
Minimum Tangent Length Between Reverse and Broken-Back Curves (ft)	250	150	100
Minimum Tangent Length at Intersections (ft) (Measured from the intersection center line)*	550	300	150
Cross-Slope (%)	2.5-3.0	2.0-3.0	2.0-3.0
Maximum Longitudinal Slope Change Not Requiring a Vertical Curve (%)	1.0	2.0	2.0
Stopping Sight Distance (ft) Height of eye 3.5 ft., and Object height 6 in.	550	325	150
Minimum Vertical Curve Length, Crest (ft) A=Algebraic Difference in Grades (%)	220 x A	80 x A	20 x A
Minimum Vertical Curve Length, Sag (ft) A=Algebraic Difference in Grades (%)	130 x A	70 x A	30 x A

*Not required on a local or collector street approach with a centerline radius \geq 400 feet or more.

TABLE 3

HORIZONTAL ALIGNMENT TAPER REQUIREMENTS

For Redirection of Through Lanes:

$$\begin{array}{llll} \text{For Speeds } \geq 45 \text{ MPH} & L & = & S \times W \\ \text{For Speeds } \leq 40 \text{ MPH} & L & = & \frac{WS^2}{60} \end{array}$$

For Entry Into Turn Bays:

$$L = \frac{S \times W}{3}$$

L = Taper Distance in Feet
S = Speed Limit in Miles Per Hour
W = Offset Distance in Feet

Minimum Length of L = 100 Feet

Length "L" Should be Extended as Required by Sight Distance Conditions

Desirable cross-street intersection spacing along arterial streets is at quarter-mile intervals. Intermediate intersections may be located a minimum of one-eighth mile from the nearest major intersection with a maximum of five intersections permitted per mile of arterial street. Desirable minimum distances between cross-street intersections are 125' along local streets, 250' along collector streets with no raised median, and 400' along collector streets with a raised median.

The maximum allowable block length is 1,200 feet and, generally, the maximum allowable length of cul-de-sac is 400 feet, measured from the intersection of the right-of-way lines at the throat to the extreme end of the bulb. Generally, "dog-leg" type cul-de-sacs are discouraged.

Bubbles are normally constructed at all two-legged intersections on local streets, see Figure 1.

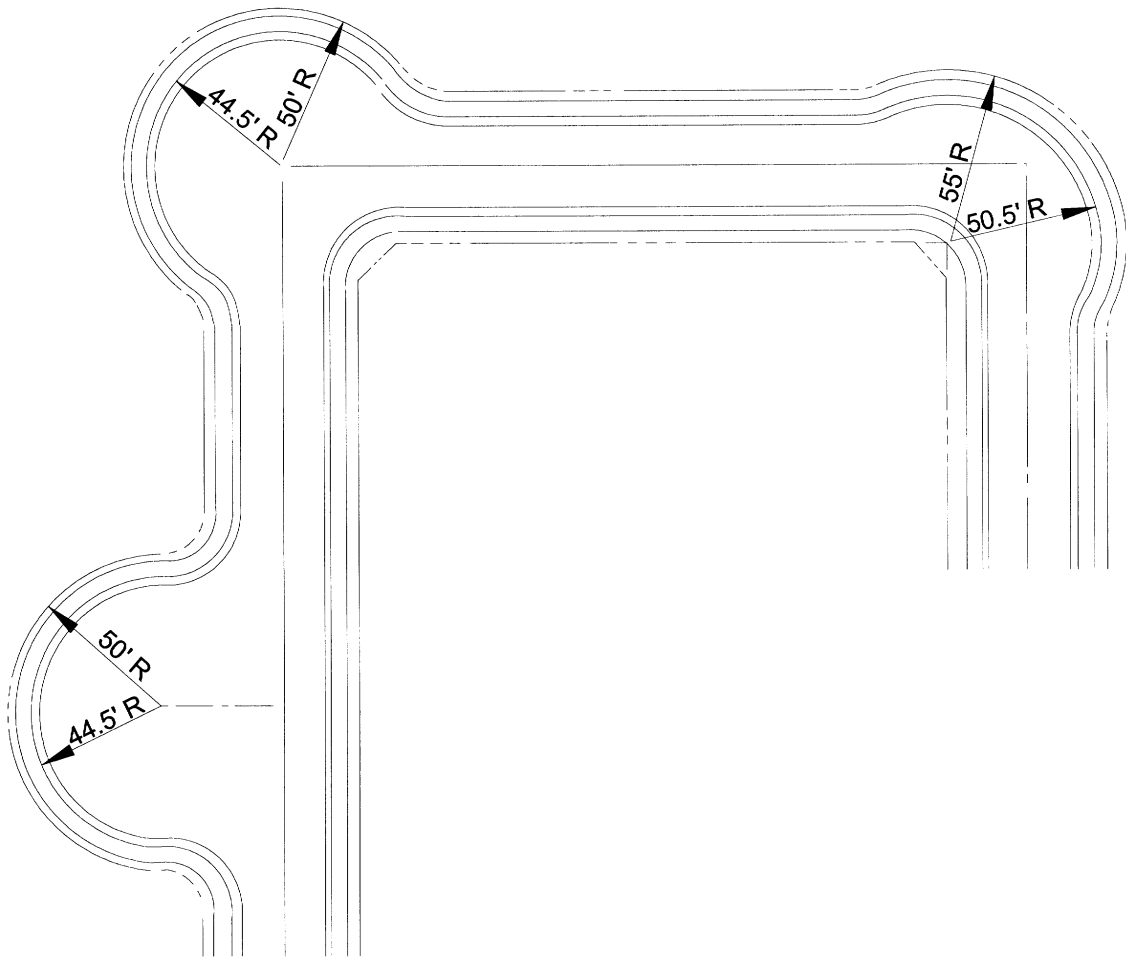


FIGURE 1 - BUBBLES FOR STREETS

3.4 Vertical Alignment

Variances to the slope requirements shown in Table 2 may be approved by the Public Works Director or his designee if the following conditions are met:

- 1) The variance must be justified on an engineering basis,
- 2) No alternatives are available,
- 3) Safety is not compromised,
- 4) Drainage problems will not be created, and
- 5) The variance benefits the City.

The minimum vertical curve lengths shown in Table 2 are preferred values. The Public Works Director or his designee may approve shorter lengths if justified by a detailed analysis and if safety is not compromised.

A design aid for street cross-slopes at intersections along arterial streets and along major collector streets is presented in Figure 2. This figure should be treated as a conceptual guideline, not an absolute requirement. The objective of this design aid is to provide for the smooth flow of traffic through intersections. The street longitudinal and cross slope requirements shown in Table 2 do not apply within the intersection, except for the maximum longitudinal slope change not requiring a vertical curve. However, positive drainage must still be achieved.

3.5 Raised Barrier Median Design

Raised barrier median ends shall be located as shown in Figures 3 and 4. A typical median end design is shown in City Standard Detail C-225. Median terminations are to be semicircular unless otherwise justified. Median breaks shall generally be constructed at one-quarter and one-half mile spacings from major intersections. All other median breaks must be justified by a traffic study.

Raised medians are to be installed on all new arterial streets. Flush medians may be installed on arterial reconstruction projects where flush medians currently exist, with approval of the Public Works Director or his designee.

When designing raised or flush medians, the left turn bays are to be constructed at their ultimate locations.

3.6 Miscellaneous Geometric Standards

1. Curb return radii requirements are given in Table 4.

TABLE 4

MINIMUM CURB RETURN RADII REQUIREMENTS

<u>Type of Intersection</u>	<u>Minimum Radii (Face-Of-Curb), ft.</u>
Arterial - All, and all intersections within industrial developments.	30
Collector - Collector, Collector - Local	25
All Others	20

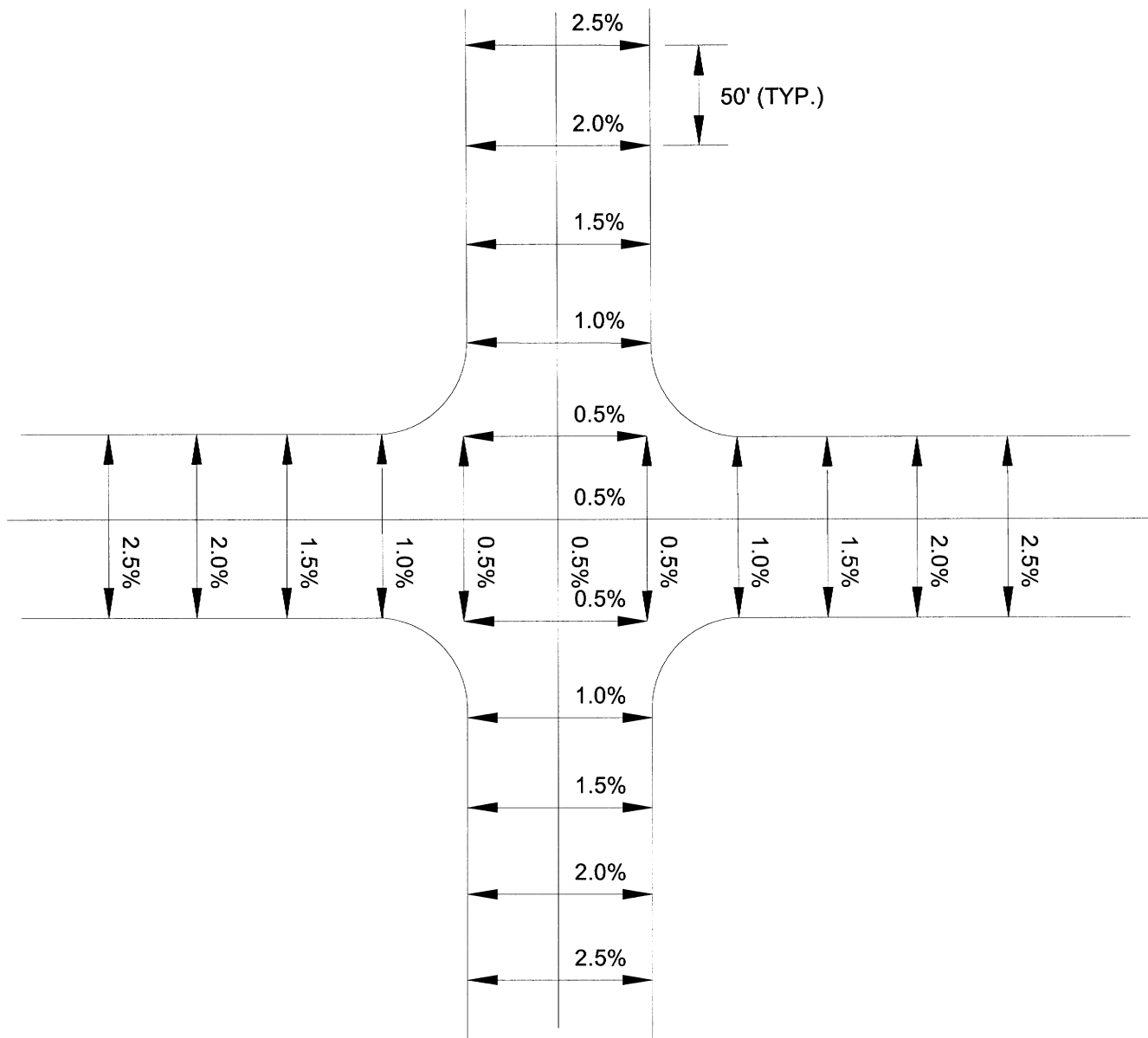


FIGURE 2 - DESIGN AID FOR MAJOR INTERSECTION CROSS-SECTION

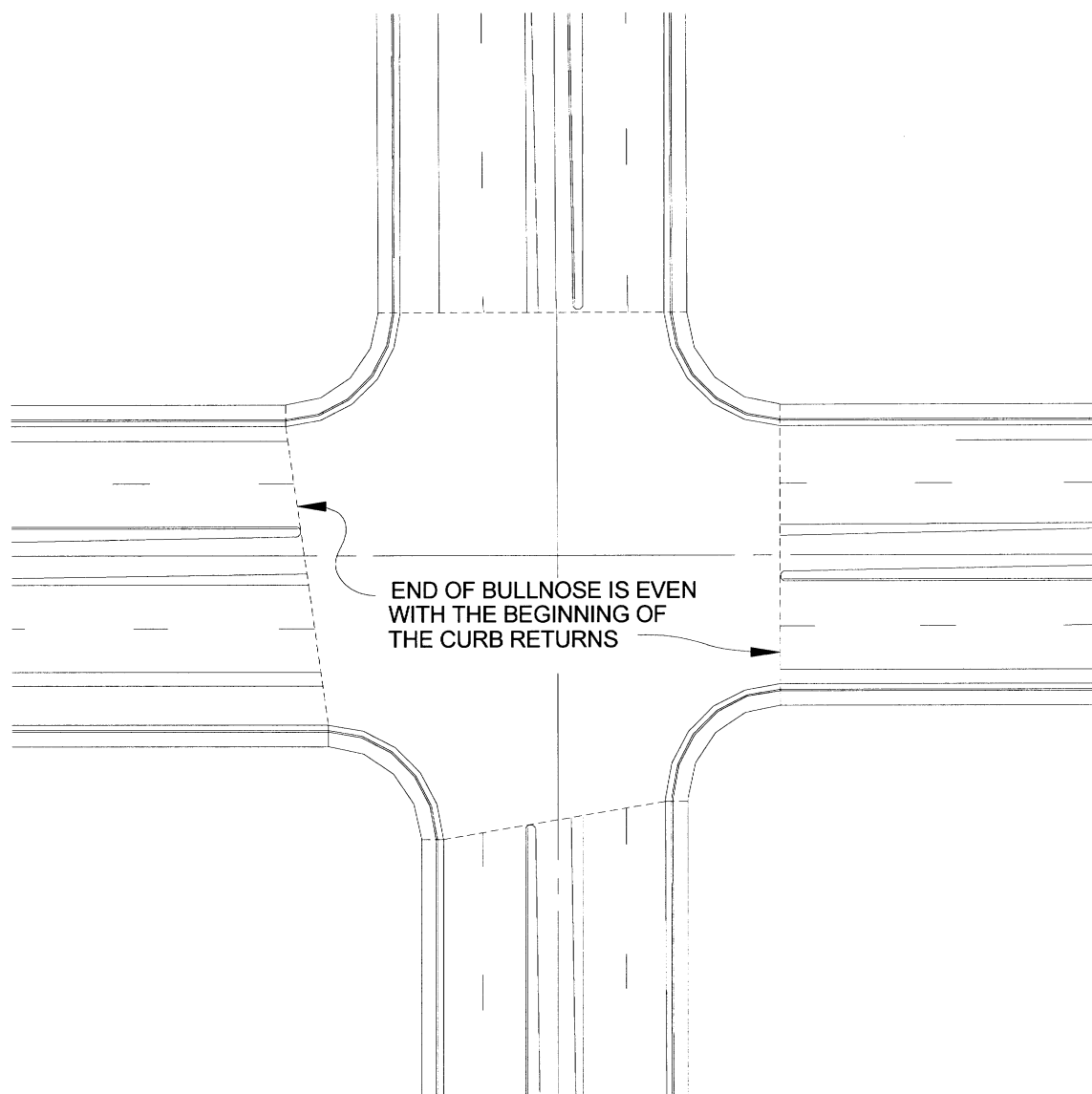
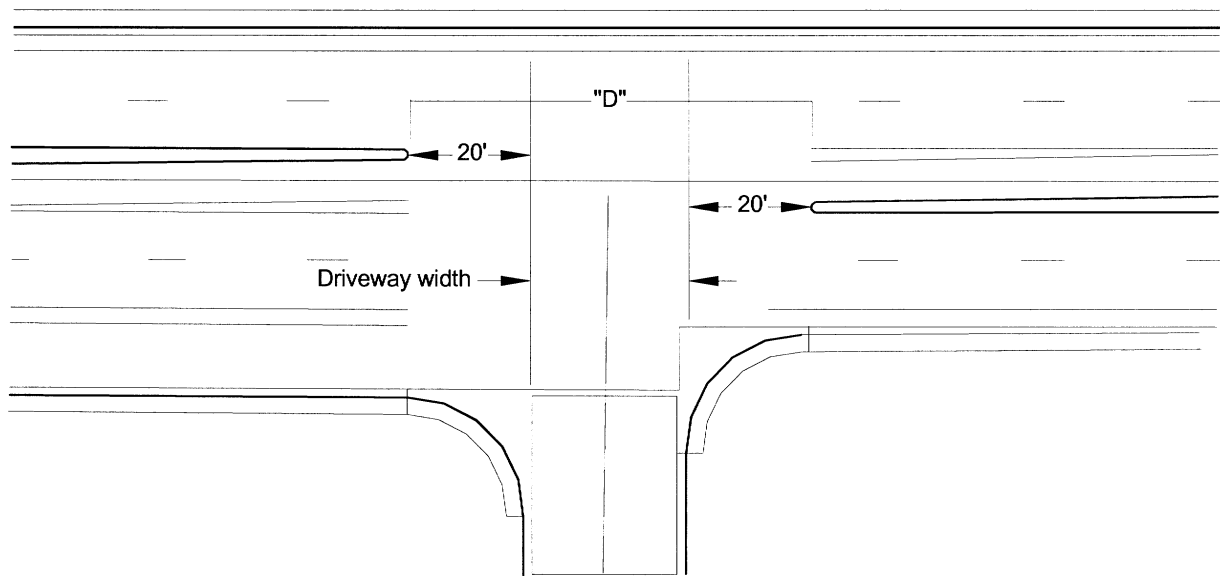


FIGURE 3 - MEDIAN BULLNOSE LOCATION AT INTERSECTION



Note:

"D" = 100' minimum median opening for driveways used by WB-50 vehicles on regular basis.

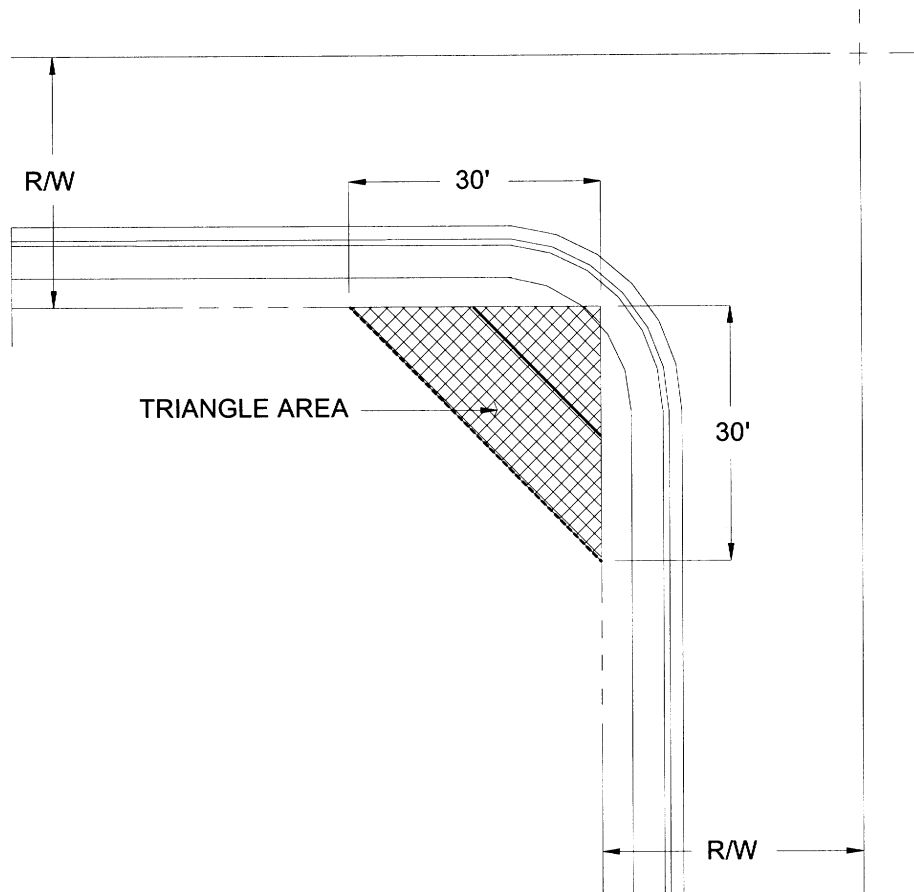
FIGURE 4 - MEDIAN BULLNOSE AT DRIVEWAY ENTRANCE

2. Corner sight distance requirements at intersections are given on City Standard Details C-246 and C-247. An additional requirement from the Zoning Code, known as the "triangle area", is shown in Figure 5. There is an additional engineering requirement for traffic control device visibility noted on Figure 5.
3. No obstructions of any type over 18 inches high, including landscaping, are allowed within 1 foot of the back-of-curb. Streetlight poles, utility poles, and similar obstructions are not allowed within 1 foot of a sidewalk. Streetlight poles are not allowed within 2.5 feet of the back-of-curb. Utility poles and similar obstructions are not allowed within 5.5 feet of the back-of-curb. Utility poles and similar obstructions may be located as close as 2.5 feet from back of curb when adjacent to deceleration lanes, parking lanes, right turn lanes or bus bays. All dimensions above refer to face-of-pole.
4. Minimum turning radii requirements for temporary turnarounds and access roads, including on-site parking and driving areas for commercial, industrial or multi-family residential sites, are given in Figure 6. When constructing a temporary turnaround the configuration, such as a hammerhead or bulb, is flexible.
5. The Fire Department requires all developments and all sub-areas within a development to be served by two independent access routes. One of these routes may be designed or controlled for use by emergency vehicles only.

3.7 Deceleration Lanes and Bus Bay Design

Left turn deceleration lanes are required on all arterial street approaches to cross-street or major driveways where left turn movements are permitted. Design guidelines for left turn deceleration lanes on arterial streets with a median are presented in City Standard Details C-225, C-226 and C-227. On arterial streets without a median (roadways not yet upgraded to City standards), temporary widening shall be constructed to accommodate a left turn lane and through lane redirection tapers as shown in City Standard Detail C-229.

Conditions requiring right turn deceleration lanes are described in Sections 7.4.2 and 7.6.2 of this manual. Right turn deceleration lanes shall conform with City Standard Detail C-231. If additional right-of-way is required above the normal right-of-way requirement in order to construct a deceleration lane or the sidewalk associated with a deceleration lane, it is the developer's responsibility to provide it. Normally, the right-of-way required will extend a minimum of 4 feet back of the sidewalk.



Notes:

Ground cover, flowers, and granite less than 2' (mature) in height and/or trees with branches not less than 6' above ground in this area.

Trees shall not be spaced less than 8' apart.

See Standard Detail No. C-246 for sight distance required at driveways and intersections for which side street approach is controlled by stop sign.

FIGURE 5 - AREA TRIANGLE

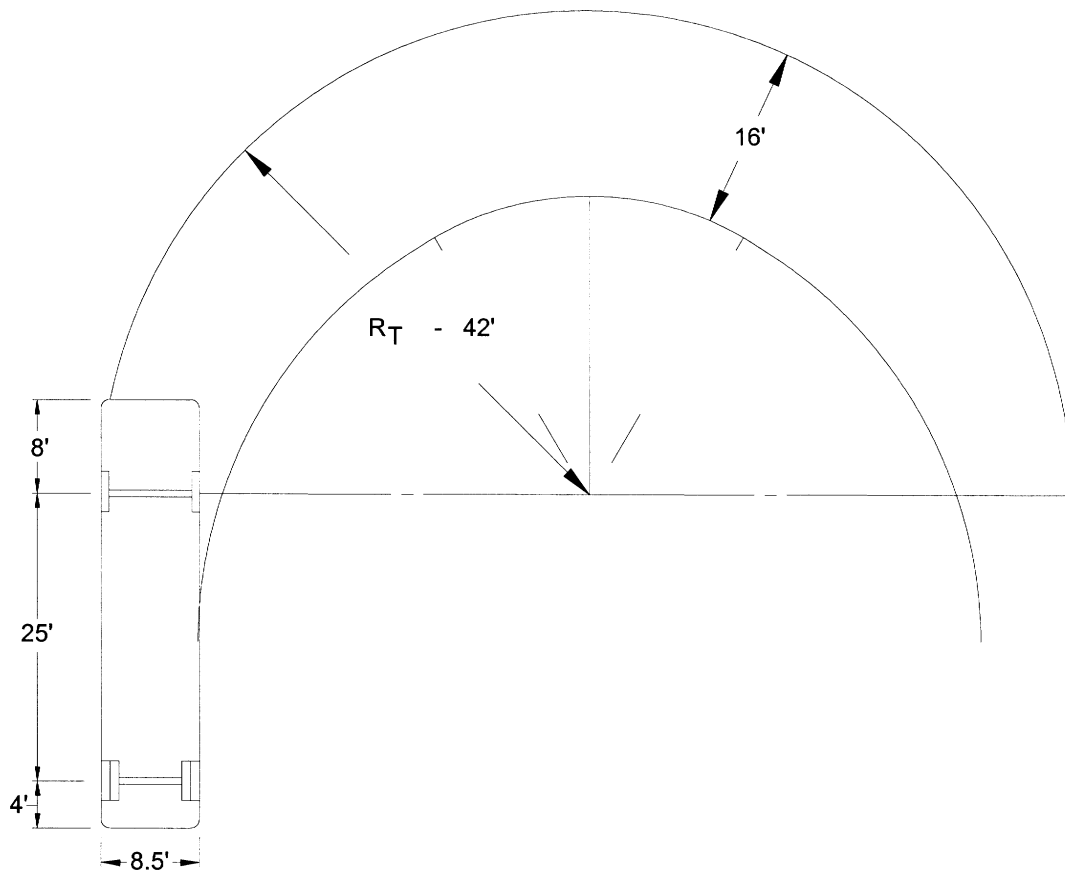


FIGURE 6 - MINIMUM TURNING RADII FOR TEMPORARY TURN-AROUND, AND FOR ON-SITE ROADWAYS PROVIDING EMERGENCY VEHICLE ACCESS.

3.8 Bus Bays or Pullouts, Bus Stops and Bus Shelters

1. Location of Bus Bay or Pullouts.

- A. All Bus pullout locations must have prior written approved of the City's Traffic Engineer and must be consistent with the City's Transit Plan.
- B. Bus pullouts will generally be placed at one mile intervals along arterial streets with existing or planned bus routes, adjusted as necessary to ensure that boarding and de-boarding will be convenient for service to abutting land uses. Additional bus pullouts, if warranted, may be spaced at one-half mile intervals, but in no case spaced less than one-quarter mile apart.
- C. Generally bus pullouts should be installed only at signalized intersections.
- D. Bus pullouts should be located at the far side of street intersections (on departures from the intersection) and within two hundred feet (200') of signalized intersections.
- E. Bus pullouts should not be installed at mid-block locations.
- F. Bus pullouts may be integrated with right-turn deceleration lanes.
- G. Bus pullouts should be located at route transfer points and layover locations at the end of bus routes.
- H. Bus pullouts should be located at stops with high peak period passenger boardings, or at stops with a high proportion of wheelchair or bicycle boardings.
- I. Right-of-way impacts and utility relocations should be avoided or minimized when determining bus pullout locations.
- J. Bus pullout locations will be prioritized and programmed in the City's Capital Improvements Program based on the following criteria: average daily traffic volumes, street lane capacity, frequency of bus service and average number of passenger boardings.
- K. The City will require dedication of right-of-way from new developments along existing and planned transit routes for construction of bus pullouts and associated shelter pads.

2. Design and Construction of Bus Pullouts

- A. Bus Pullouts shall be constructed of concrete and designed in accordance with City of Chandler Standard Details and Specifications C-230 when not integrated with a deceleration lane and with C-231 when integrated with a deceleration lane.

- B. Bus pullouts should be incorporated into the design and construction of larger

arterial street and intersection improvement projects to reduce costs.

- C. All bus pullouts should include a concrete pad of sufficient dimensions located behind the adjacent sidewalk to accommodate a passenger shelter, bench, trash receptacle and advertising/information kiosk.

3. Design and Construction of Bus Stops and Bus Shelters

- A. Advertising at bus stops located on arterial streets in nonresidential areas should be permitted to offset the costs of installing and maintaining passenger shelters and associated fixtures.

- B. Advertising revenues will be used to offset fixed-route transit operating costs.

- C. All new passenger shelters should be lighted or located in proximity to an existing streetlight.

- D. Where irrigation is available, landscaping and shade trees should be provided in proximity to the shelter pad to increase shade to the passenger waiting area.

- E. The design of developer installed bus shelters and associated fixtures require prior written approval of the City's Transit Manager and Landscape Architect before instruction. Shelter ownership, long-term maintenance responsibilities, and replacement cost due to damage are primary considerations.

- F. All new bus stops shall meet the accessibility requirements set forth under the Americans with Disabilities Act (ADA).

4. Location of Bus Shelters

- A. Bus shelters should only be installed along streets served by a transit route.

3.9 Drainage Structures

Valley gutters are not allowed to cross major collector or arterial streets under any circumstances.

Eight-foot valley gutters are to be used for drainage crossing minor collectors and local streets respectively where there is no stop control for through traffic. Three-foot valley gutters are to be used where there is stop control for through traffic. See C.O.C. Std. Detail C-233.

Curb opening inlet type catch basins are preferred over combination inlet opening type catch basins. That is not to say that combination inlet type catch basins are not allowed, they just have a higher maintenance cost due to the presence of the grate opening.

The installation of scuppers is required when utilizing roadside retention basins, see City Standard Detail C-500.

Storm drains are normally installed whenever the 10-year design storm flows cannot be contained within the top-of-curbs. However, the installation of 7-inch vertical curb instead of the standard 6-inch vertical curb may eliminate the need for storm drains. The use of 7-inch vertical curb requires special approval of the Public Works Director or his designee and may only be installed on short sections of street near the drainage inlets.

3.10 Arterial Street Lane Widths

All newly constructed or reconstructed arterial streets shall be marked with bike lanes. Arterial street bike lanes shall generally be five feet wide, not including any part of an adjacent gutter pan. Vehicle lane widths on a six-lane arterial street shall be 12 feet for lanes next to the median and next to the bike lanes, and 11 feet for the center through lane in each direction of flow. See COC Standard Detail C-619.

For remarking of existing arterial streets, lane widths are as follows:

- A two-way left turn lane shall be at least 10 feet wide, 10.5 feet preferred.
- A vehicle through lane shall be at least 10.5 feet wide, 11 feet preferred.
- A vehicle through lane next to a median curb or bike lane shall be at least 11 feet wide, 12 feet preferred.
- A bike lane shall be at least four feet wide, but the bike lane shall be increased to a width of five feet where possible with the preferred vehicle lane widths listed above. Gutter pans shall not be included in the measurement of bike lane widths.

Along existing arterial streets too narrow to provide bike lanes, the outside lane will be made as wide as possible by using the minimum vehicle lane widths described above for the center and inside lanes.

SECTION IV

IV. PAVEMENT STRUCTURAL DESIGN STANDARDS

4.1 Flexible Pavement

City Standard Details C-203 through C-222 for street cross-sections also include notes referring to the appropriate City Standard Detail for asphaltic pavement thickness and the appropriate MAG Standards for material requirements.

4.2 Rigid Pavement

Rigid pavements, such as portland cement concrete, are generally not used for City streets. If rigid pavements are used, each design must be approved by the Public Works Director or his designee on an individual basis.

4.3 Decorative Pavement

The use of decorative concrete must be approved by the Public Works Director or his designee. Red or gray color tones shall be used, with stamped patterns similar to patterns specified for paving blocks (City Standard Details C-236 through C-238). Decorative concrete will not be placed in arterial through lanes. When approved, it shall be constructed in accordance with MAG Standard Specifications Sections 340 and 725 (Class A concrete) with a minimum thickness of 8 inches. If the concrete is not placed monolithically, the surface course shall be placed within 4 hours of the base course with a minimum thickness of 1-1/2 inches and finished in accordance with manufacturer's recommendations.

The use of interlocking paving blocks must be approved by the Public Works Director or his designee. When approved, they shall be installed in accordance with City Standard Details C-236 through C-238. In addition a minimum of 25 paving blocks of the type installed must be deposited free of charge at the City's maintenance yard for future City maintenance operations.

4.4 Miscellaneous Pavement Standards

For cases where the full depth of base course cannot be constructed due to insufficient cover over existing facilities, the City reserves the authority to approve equivalent alternate designs if justified.

The minimum pavement cross-sectional requirement for temporary turnarounds, which are constructed at project phase lines, is 6 inches of aggregate base course over 6 inches of subgrade; see MAG Standard Specifications Sections 301, 310 and 702. If the temporary turnaround is constructed at a project boundary, a surface course of 2 inches of asphaltic concrete is required in addition to the base and subgrade noted above; see MAG Standard Specifications Sections 321 and 710, without lime.

Temporary pavement cross-sections shall consist of 2 inches of asphaltic concrete over 6 inches of aggregate base course over 6 inches of subgrade, see the same MAG Standard Specifications Sections noted above.

SECTION V

V. MISCELLANEOUS STREET STANDARDS

5.1 Traffic Control Devices and Street Name Signs

If new development requires the relocation of existing traffic signals, the developer is responsible for the redesign and all costs associated with reconstruction. The redesign must be submitted to the City for approval prior to relocation.

Yield signs may be placed at intersections with no acceleration lane where the safe entry speed is greater than 10 MPH. All yield sign use and placement shall be by the approval of the Public Works Director or his designee.

All signs must be manufactured of “ASTM D-4956-04 Type IV Sheeting” which will be attached to the standard signage aluminum plates. Sign imaging shall be in compliance with the reflective sheeting manufactures matched component system. Sign imaging shall consist of an acrylic based electronic cuttable film or silk screened using inks (depending on the quantity of signage) with standard highway colors.

Barricades, MAG Standard Detail 130 Type "B", are required at all dead end streets and street stub-outs, except cul-de-sacs. An end of road marker (18"x18"), MUTCD OM4-3 (retroreflective red diamond panel), spaced on 5 foot center along the barricade are required. A turn-around area is also required (see Sections 3.6 of this manual).

Deceleration and right-turn lanes are signed and striped in accordance with Detail C-620 of the Standard Details and Specifications Document.

Speed limit signs, MUTCD R2-1, are installed on all local and collector streets at approximately 100 to 200 feet from arterial intersections. Speed limit sign locations on arterial streets are shown in Detail C-621 of the Standard Details and Specification Document. The posted speed limit for local streets is 25 mph. The posted speed limit for collector and arterial streets is determined by the City Transportation Engineer, based upon individual circumstances. No parking signs, MUTCD R8-3a, are 24" x 24" on arterials and 18" x 18" on all other streets.

Arterial and collector signage and striping standards are shown on Detail C-600 through Detail C-623. Reflective markers are required on all arterial streets. On collector streets reflective markers are required only along street sections with unusual conditions, such as: intersection approaches where through lanes converge after the end of a median or left turn lane. Where conditions require use of reflective markers, the markers are to be installed from a point 500 feet or more in advance of the conditions to a point 500 feet or more beyond the conditions. Pavement markers shall be prismatic reflectors only.

Typical median signage is shown on Detail C-600 of the Standard Details and Specifications.

Typical railroad crossing signage and striping is shown on Figure 11.

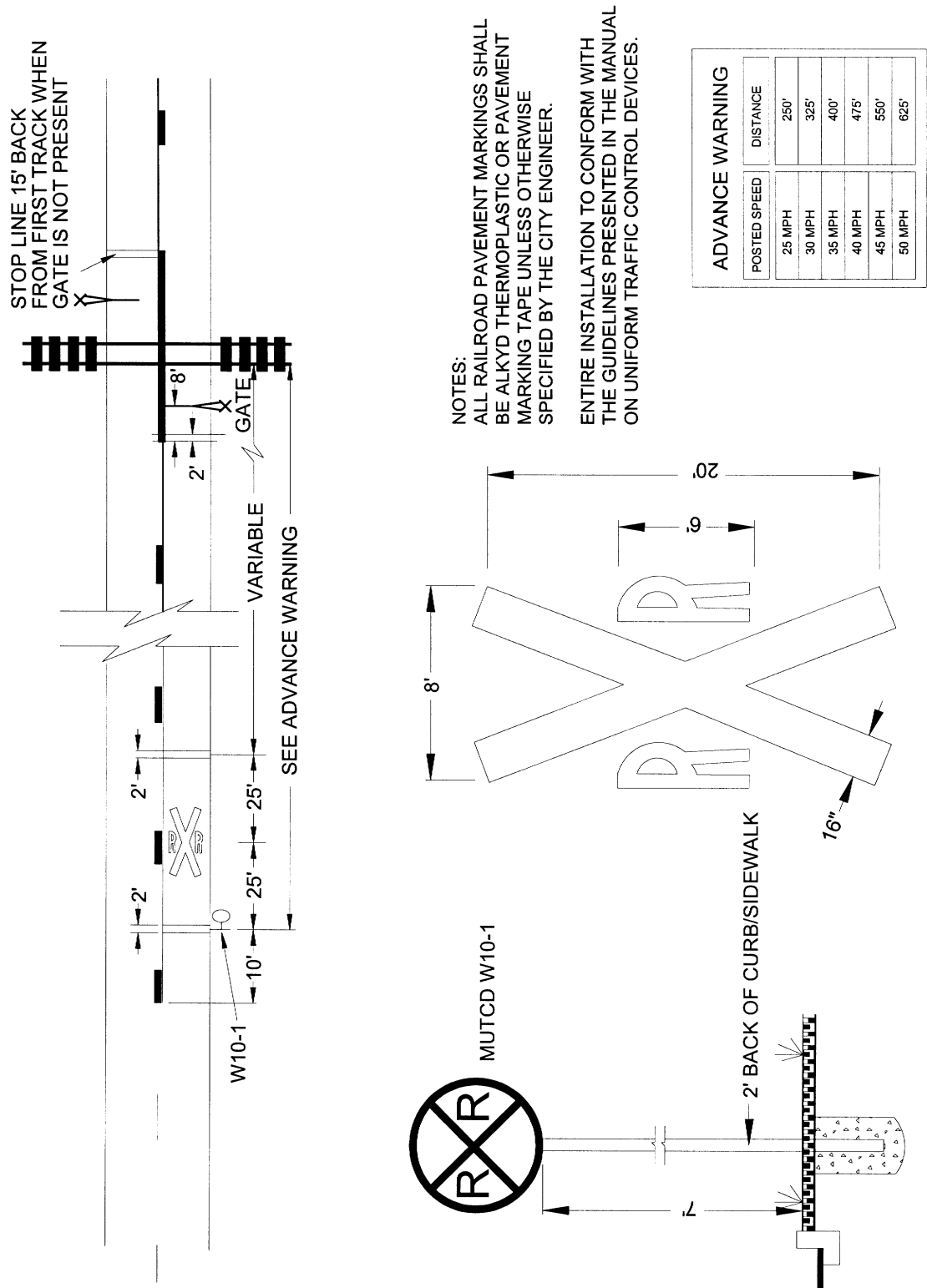


FIGURE 11 – RAILROAD MARKINGS

Non-arterial intersections, and lower classification street intersections with arterials, are normally stop controlled. Sufficient sign bases are required at all intersections for the installation of stop signs and street name signs.

The street name signs will be installed by the City after payment of the prevailing fees by the developer. This is the only case where the City will perform any work associated with a development.

Signal conduit, 4-inch diameter schedule 40 PVC with detectable mule tape and with ADOT No. 7 pull boxes, is installed at all legs of arterial intersections where median breaks are present, including arterial-arterial intersections. See ADOT Standard Detail T.S. 1-4 for No. 7 pullbox.

All signal interconnect infrastructure shall be “fiber friendly” regardless of the material installed. Interconnect conduit shall be 4-inch conduit with three 1- ¼ inch innerducts colored red, orange, and black. All unused innerduct shall have 2500-lb detectable mule tape installed with detectable members spliced across pullboxes, creating a continuous detectable run. ADOT standard #9 pullboxes shall be installed at all arterial/arterial intersections, or as designated by Traffic Engineering staff. ADOT standard #7 pullboxes with extension shall be installed at ¼ mile intervals, or as designated by Traffic Engineering staff. All conduits shall enter pullboxes with 45° sweeps with no less than a 36-inch bend radius. Every effort shall be made to minimize variations in the conduit profile (i.e. bends, vertical & horizontal shifts, etc.)

5.2 Partial Street and Half-Street Standards

Generally, a developer is required to construct the full street cross-section for the streets internal to the development and a portion of the streets surrounding the development. For half street designs other than local streets, a 24 feet width from face of curb and a striping plan are required. For half street designs of collector and arterial streets, the plans should show the preliminary grades for the future opposite curb line. The partial street construction standards for the surrounding streets are as follows:

Local street: 24.5 feet to back of curb plus sidewalk on the side of the street adjacent to the development. Streetlights are also required.

Collector street without median: Same standards as previously noted for a local street, except in the case of an industrial collector the width required is 32.5 feet to back-of-curb.

Collector street with median: The entire one-half of the street adjacent to the development plus a full median and one opposing lane. Full median improvements include curb, landscaping, irrigation and streetlights.

Arterial street: The entire one-half of the street adjacent to the development plus a full median and one opposing lane. Full median improvements include curb, landscaping, irrigation and streetlights. The developer may be required to construct additional improvements on the opposite side of the street centerline if deemed necessary by the Public Works Director or his designee. This includes, but is not limited to, extension of driveways on the opposite side of the roadway to meet the half-street improvements.

Temporary asphalt (2" AC on 6" ABC may be used).

All streets: Pavement tapers shall be constructed to provide transitions between newly constructed and existing roadway sections, as deemed necessary by the Public Works Director or his designee. If right-of-way not on the developer's property is needed to construct the required street improvements, it is the developer's responsibility to provide it.

5.3 Phasing Requirements

Each successive phase of a development must satisfy all of the requirements given within this manual. In addition, all arterial street improvement requirements must be satisfied with the first phase. In the case of large developments, the City reserves the right to require satisfaction of collector street improvement requirements with the first phase.

5.4 Private Streets

Private streets are subject to all of the requirements for public streets except for the minimum allowable widths shown in Table 5. Continuous through streets cannot be comprised of both public and private roadway sections.

TABLE 5
MINIMUM WIDTH REQUIREMENTS FOR PRIVATE STREETS

<u>Parking Condition</u>	<u>Back-Of-Curb To Back-Of-Curb Width (ft)</u>	<u>Private Street Right-Of-Way Width (Ft)</u>
No Parking	25	33
Parking on One Side	29	37
Parking on Both Sides	35	43

Street name signs, City Standard Detail C-605, shall be installed at all private street intersections. The City shall install street name signs provided by the developers.

5.5 Streetlights

Streetlights shall be positioned a minimum of one foot back of the sidewalk or a minimum of 2.5 feet from the back of curb to the face of pole. Streetlight poles may be placed in the median where the median width is sufficient to maintain a minimum distance of 3-feet or more from the back of curb to the face of pole.

5.6 Traffic Calming Devices

Traffic calming devices are required along all newly constructed local streets with single-family residential frontage on straight or nearly straight segments over 600 feet in length. Typical traffic calming devices are speed humps (City Standard Detail C-234), traffic circles, raised crosswalks, chicanes, and chokers. Traffic calming devices should be spaced about 300 to 500 feet apart and should generally be at least 200 feet away from a stop-controlled intersection or right-angle turn in the roadway. Contact Traffic Engineering at 480-782-3454 to suggest and approve traffic calming options.

SECTION VI

VI. PLAN REQUIREMENTS

All off-site construction plans, except landscaping, shall be prepared and signed by a professional engineer who is qualified and registered by the State of Arizona to practice in the particular field of competency required by the type of improvements. Landscaping plans shall be prepared by a landscape architect that is qualified and registered by the State of Arizona.

Plans shall be submitted on 24" x 36" sheets. The plans shall be drawn to an engineering scale. Architectural scales are not allowed, including landscaping plans.

There are no specific engineering scale requirements, but one inch equal to 20 feet and one inch equal to 40 feet are the preferred horizontal scales. The vertical scale, when profile is required, need not differ from the horizontal scale by a precise factor of 10. Water, sewer, and paving plans for non-arterial streets may all be shown on the same plan sheets if a horizontal scale no smaller than one inch equal to 40 feet is used. Arterial street plans must always be prepared at a horizontal scale of one inch equal to 20 feet. Separate plan sheets must be shown for:

- paving plans
- signs, pavement markings (with streetlights as a background layer)
- street lighting
- landscaping, and
- water and sewer plans

Requirements for street lighting are given in the City's Streetlight Design Manual.

All landscaping within arterial street rights-of-way must be reviewed and approved by the Public Works Landscape Architect. All plant material must comply with the Arizona Department of Water Resources approved "Low-Water" list. Refer to the City's Guidelines for Landscaping and Irrigation of Rights-of-Way, Retention Basins and Park Development for additional information.

All elevations shown on the plans shall be referenced to a benchmark on the City datum unless otherwise approved by the City Engineer.

Additional plan requirements are given in the pavement and street light plans checklists. The checklists are to be included with paving and/or street light plans with each submittal for City review. The most current versions of the City's general, paving, and street light plan notes, and pavement and street light checklists, are available at the Development Services Counter, 215 East Buffalo Street.

SECTION VII

VII. ACCESS CONTROL POLICIES AND GUIDELINES

7.1 General Considerations

These guidelines are to be used in the planning, design and approval of access to the arterial street system. The arterial street system is as defined in the Chandler Transportation Study and generally consists of all section-line roadways within the City of Chandler.

The primary function of the arterial street system is to provide mobility for intra- and inter-city travel. Access to abutting land is secondary to providing a high level of mobility and safety.

7.1.1 Planning Review Process

A traffic impact study is required when the size of the development exceeds the following:

Retail	80,000 sq. ft.
Office	150,000 sq. ft.
Residential – single family	300 units
Residential – multi-family or apartment	500 units
Industrial	200,000 sq. ft.

Where a development does not fall into any of the above categories, a traffic impact study is required when the number of trips generated by the development exceeds 300 trip ends in any one peak hour.

Traffic studies will also be required for any access proposals, which do not substantially comply with these guidelines, or as directed by the City Transportation Engineer. The scope of work for the Traffic Impact Study may be obtained from the Traffic Engineering Office at (480) 782-3454. The cost of traffic analyses as well as the cost for implementing recommendations shall be the responsibility of the access requestor.

7.1.2 Traffic Impact Assessments

All traffic reports shall contain, as a minimum, the following information:

1. A summary table listing each type of land use, the units involved, the trip rates used (daily as well as peak period), and the resultant trip generation.
2. A site plan that shows proposed accesses, on-site circulation and the location within the site of each land use.
3. A.M. and P.M. peak hour traffic turning movements estimated for site accesses at buildout of the site, in combination with non-site traffic volumes.
4. Traffic operational analyses for the proposed accesses, for A.M. and P.M. peak hours.

The following additional elements may be required for large developments:

5. A.M. and P.M. peak hour traffic turning movements projected for arterial-arterial and arterial-collector intersections up to one mile from the site.
6. Traffic operational analyses (intersection levels of service and progression analyses) along arterial streets up to one mile from the site.

Intersection level of service "C" shall be the design objective. If level of service "E" or "F" is estimated by the Study, then alternative means of attaining level of service "D" shall be analyzed and included as part of the study. Generally, the design year will be approximately 15 to 20 years following construction. The base volumes for non-site traffic shall be the interim development forecast available from the Chandler Transportation Plan.

Traffic consultants are invited to discuss projects with the Public Works Director or his designee prior to study start. Doing so will provide an opportunity to resolve any differences of opinion on traffic study requirements.

7.2 Definitions

The following terms are used throughout the Guidelines:

- Major intersection: The intersection of any principal arterial (freeway or expressway) major or minor arterial with any major or minor arterial. These intersections are typically found at the section corners as the section-line roadways intersect. The intersection of two principal arterials normally requires an interchange.
- Intermediate intersection: The intersection of any collector or local street or major driveway with any major or minor arterial functioning as the through roadway.
- Major generator: Any development (commercial, industrial, residential or mixed use) which generates more than 5,000 trips per week day.
- Major driveway: Any driveway which intersects a major or minor arterial and serves the main parking area of a major generator, with all movements permitted.
- Minor driveway: Any non-major driveway which provides access to a major or minor arterial. The access can be full, i.e., all movements permitted, or with certain movements restricted.

7.3 Access Locations Along Arterial Streets

General access to the arterial network is provided by intersections with collector and local roadways and by major and minor driveways to developments. The spacing of access intersections will vary between the arterial functional classes, according to the level of land access which may be allowed.

7.3.1 Access Spacing - Principal Arterials

Principal arterials are being designed with grade-separated crossings of section-line arterial streets within Chandler. Direct land access to principal arterials is not permitted, although frontage roads with direct land access are planned for some locations.

7.3.2 Access Spacing - Arterial Streets

Arterial streets intersect at-grade with each section-line arterial.

Intermediate intersections with collector and local roadways and major driveways should be limited to a maximum of five per mile. Intermediate intersections may be located a minimum of one-eighth mile from the nearest major intersection. Desirable intersection spacing is at quarter-mile intervals. Intersections should be located at consistent intervals to allow for two-way traffic-signal progression.

Direct land access should be controlled, and new residential developments shall not front an arterial street. Right-in, right-out access points may be allowed based on travel demand. Minimum distances between access points are discussed in Section 7.5.

7.3.3 Traffic Signal Locations

Traffic signals will be located at each major intersection (arterial street intersections with other arterial streets or ramps accessing principal arterials) upon satisfaction of warrants contained in the current edition of the Manual on Uniform Traffic Control Devices.

Intermediate intersections may be equipped with traffic signals depending upon satisfaction of warrants. Warrants must be used in conjunction with professional judgment based on experience and consideration of related factors.

Traffic signals should be located where timings of successive signals may be coordinated to allow progression in both directions of movement. Signal spacing must be on consistent intervals along an arterial to allow two-way progression. Two-way progression is not mandatory but is highly desirable.

Traffic signal locations between major intersections should be kept to a maximum of three installations, ordinarily at the half- and quarter-mile points. Slight shifts from quarter-mile signal spacing locations are permissible depending upon a review of storage length requirements and traffic progression impacts. (Shifts of up to 50 feet in either direction from the quarter-mile spacing point do not require analysis.) Upon satisfaction of warrants for installation of a traffic signal, a semi-actuated traffic signal may be considered at an intermediate intersection or major driveway located at other than quarter-mile spacing. City approval or denial will be based on review of a traffic impact assessment report evaluating effects of the proposed median opening and signal on provision of sufficient taper and storage lengths for turn lanes, and on progression of through traffic along the arterial street.

7.4 Planning and Design for Intersections

7.4.1 Allowable Intersection Types

Design types permitted for major intersections on arterial streets are as follows:

- Basic crossing with four legs.
- T-intersection with three legs.
- Roundabouts

No five- or six-leg intersections.

7.4.2 Provision of Turn Lanes

Left turn and right turn lanes shall be provided on all approaches to major (arterial-arterial) intersections. Left turn lanes shall be provided on all approaches to intermediate intersections, and right turn lanes shall be provided where warranted by projected traffic demands (per Section 7.6.2) at arterial-collector and arterial-local intersections. In addition, sufficient right-of-way for three through lanes, two left turn lanes, and a right turn lane on each approach shall be provided at all major arterial/major arterial intersections as shown in City Standard Detail C-223.

Where turn lanes are constructed, length of storage lanes shall be a minimum of 100 feet. Turn lane lengths at intersections for which traffic signals may be warranted shall be designed to accommodate 15 to 20-year traffic demands with less than a 5-percent probability of overflow during peak flow periods. Lane transition/taper should be determined based on the arterial design speed (see Table 3 and C.O.C. Std. Detail C-231) but shall be a minimum of 100 feet. In most cases, it is preferable to provide more turn-lane storage rather than longer taper lengths.

Where the demand warrants and cross-sectional widths are available on both the intersecting streets, dual right-turn and/or left-turn lanes can be incorporated.

7.4.3 Provision of Medians

All arterial streets within the City will be provided with medians. Raised medians shall be installed on all new arterial streets, and will be constructed with curbs and landscaping. Flush medians may be installed on arterial reconstruction projects where flush medians currently exist, with approval of the Public Works Director or his designee. Flush medians will be continuous paved medians marked in accordance with the current edition of the Manual on Uniform Control Devices.

Collector streets will generally be constructed with flush medians. Flush medians allow for two-way left-turn lanes and should be incorporated as a minimum design treatment on all streets of four lanes or more.

7.4.4 Provision of Median Breaks

Median breaks will be provided at all intermediate intersections as identified in Section 7.3.2. Breaks should not be planned unless adequate geometrics are available; i.e., sufficient storage/ deceleration length, lane width, etc. Median breaks in addition to the quarter-mile and half-mile points will be considered within the first quarter-mile from the major intersections. These breaks should be located at the eighth-mile point (660 feet) from the major intersection. Median breaks will not be allowed in medians of less than 14 feet in width. Left-turn bays should always be protected by the median.

7.4.5 Intersection Sight Distance

Stopping sight distance is the minimum sight distance allowable for all intersection approaches. Minimum stopping sight distances are shown in Table 7 for flat terrain. Roadways on grade will increase or decrease these distances, and in such cases, references such as the American Association of State Highway Official policies and guidelines for roadway design should be consulted.

TABLE 6

Minimum Stopping Sight Distances

<u>Design Speed</u>	<u>Distance (Feet)</u>
25	150
40	325
55	550

Three types of movements for traffic entering a major street from a minor side street or driveway result in three different sets of sight distance requirements:

1. Right turns from the minor street onto the major street
2. Left turns from the minor street onto the major street
3. Left turns into the intersection or access point from the major street

Sight-distance requirements for entering arterial or collector streets are shown on City Standard Detail C-246. Heights of buildings, walls, landscaping and other similar obstructions should be restricted within the sight triangles. Sight distance is measured from a driver's eye height of 3.5 feet to an approaching target 4.25 feet high.

Along local or collector streets with residential frontage where motorists can expect frequent conflicts with vehicles entering or exiting driveways, a minimum sight distance of 200 feet is required, as illustrated in City Standard Details C-247 and C-248. As explained above for arterial and collector streets, heights of obstructions should be restricted within the sight triangles to provide a clear field of vision from a driver's eye height of 3.5 feet to an approaching target 4.25 feet high.

7.5 Access Driveway Location

7.5.1 Number of Access Points

Arterial street access to any parcel with less than 200 feet of arterial street frontage shall be limited to one two-way driveway or one pair of one-way driveways on that frontage. Access points should conform to Section 7.5.2 of these guidelines concerning spacing between access points. Additional driveways may be permitted if the following conditions are met:

1. Driveway two-way volume exceeds 1,500 vehicles per day with build-out of site.
2. Traffic volumes exiting the site under build-out conditions exceed capacity of stop-sign controlled intersections during peak hour of street or peak hour of site.
3. Traffic impact analysis determines that two driveways are required to safely and efficiently accommodate demand.

Developers of large sites or abutting sites along arterial streets should seek to consolidate major driveways at the appropriate intermediate intersection/median break points identified in Sections 7.3.2 and 7.4.4. Such consolidation may assist in meeting traffic signal warrants and in providing for acceptable signal progression on the through street. Additional minor driveways along arterial street frontages should meet spacing guidelines of Sections 7.5.2 and 7.5.3.

Residential developments should have at least one access per 200 single-family residential units, one access per 350 multi-family units, or one access per 350 mobile homes. Developers proposing fewer accesses for their project must provide a traffic study showing acceptable levels of service.

7.5.2 Access Point Spacing

Figure 12 shows recommended minimum spacing between driveways and adjacent intersections, driveways and median ends along arterial and collector streets. Location of major driveways (serving a major generator, with no restriction of turning movements) is controlled by distances needed for provision of left turn storage lanes and approach tapers. Major driveways on opposite sides of the street should be aligned to accommodate cross travel and to avoid conflicts between left-turning vehicles. Where a flush median design is used (two-way left turn lane), minor driveways on opposite sides of the street should either be aligned or offset a minimum of 200 feet along arterial streets and 100 feet along collector streets. All driveways, including minor driveways restricted to right turn movements, should be spaced at least 100 feet apart along arterial streets and 50 feet apart along collector streets.

7.5.3 Access Point Intersection Clearance

Minimum corner clearances at public intersections are shown in Figure 12. Where narrow lot widths do not permit the enforcement of the minimum clearances, an absolute minimum corner clearance of 50 feet may be used. On arterial streets, left turns into and out of such a driveway shall not be permitted.

7.6 Access Driveway Design

7.6.1 Curb Return Radius and Width

All driveways onto arterial streets shall be constructed with curb returns. Recommended dimensions are shown in Table 7.

TABLE 7

Recommended Driveway Dimensions Along Arterial And Collector Streets (F/C)

Parameter	Arterial Street			Collector Street		
	MF Res.	Comm.	Indus.	MF Res.	Comm.	Indus.
Min. Width (1-way)	16'	16'	16'	16'	16'	16'
Min. Width (2-way)	24'	24'	24'	24'	24'	24'
Max. Width	30'	40'	40'	30'	40'	40'
Min. Corner Radius	20'	20'	25'	NA	20'	25'
Max. Corner Radius	20'	25'	30'	NA	25'	30'

Note: Abbreviations are MF RES. for Multi-Family Residential, Comm. for Commercial and Indus. for Industrial land uses. Single family residences are not allowed direct access to arterial streets. See Section 3.7 on page 14.

Where high pedestrian traffic is expected (e.g., in the central business district or close to a high school, auditorium or library), a maximum width of 30 feet is desirable. Where large truck movements are expected on a regular basis (5 or more trips per day), the corner radius and driveway lane width should be designed to accommodate the truck turning path without encroachment on the arterial street parallel traffic lane or the driveway opposing traffic lane.

7.6.2 Right Turn Deceleration Lanes

A right turn deceleration lane shall be provided at cross streets and driveways when projected right turns into the site exceed 20 vehicles for a typical peak hour.

Where successive driveways warranting provision of right turn deceleration lanes are less than 400 feet apart (nearest edge to nearest edge), a continuous right turn lane rather than separate right turn lanes shall be constructed. Where a driveway warranting provision of a

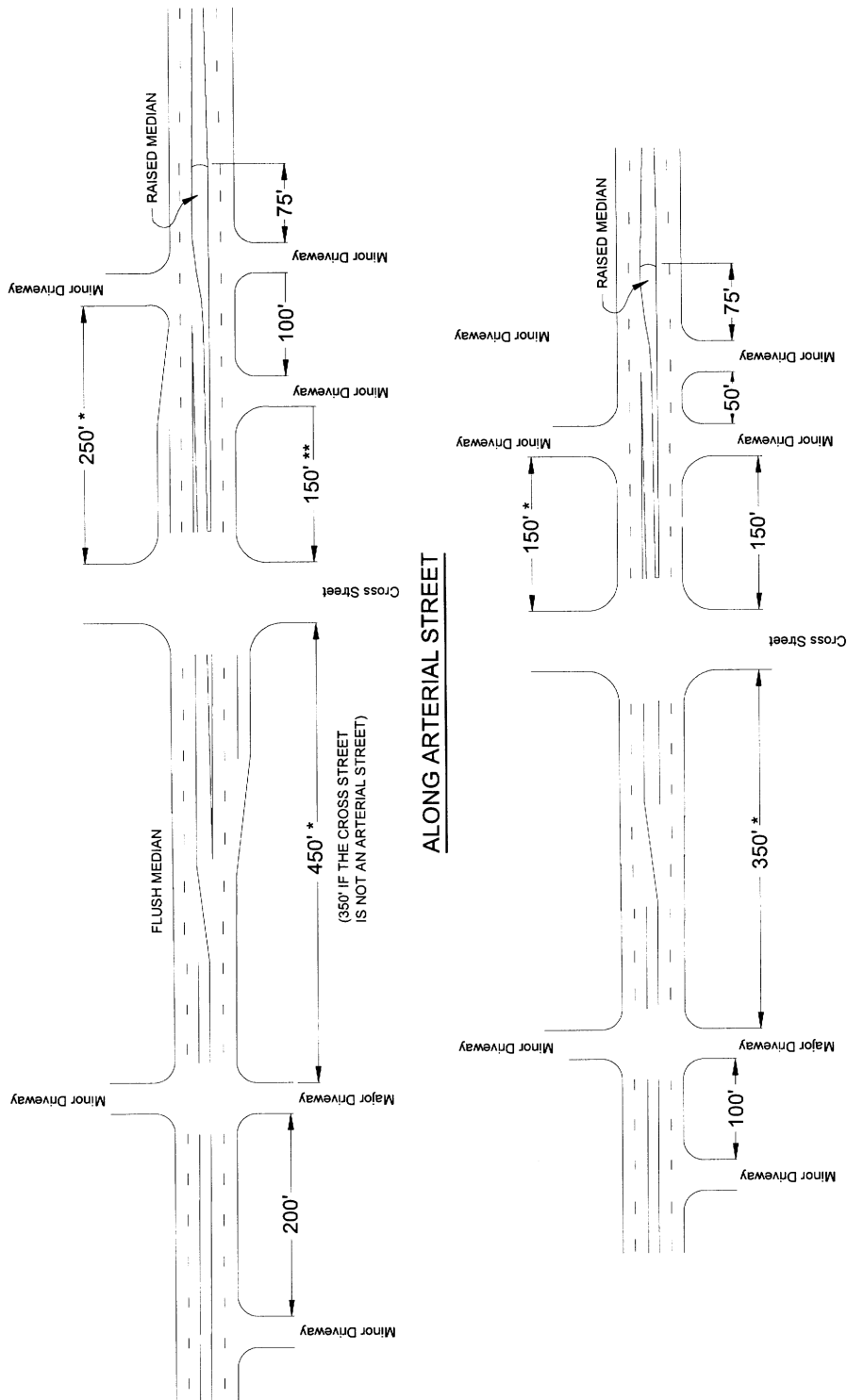
right turn deceleration lane is located less than 450 feet in advance of an arterial cross street, a continuous right turn lane rather than separate right turn lanes shall be constructed. The minimum right turn/deceleration lane length is 100 feet. (Also see Section 3.7 on page 14 and C.O.C. Std. Detail C-231.)

The City Transportation Engineer on a case-by-case basis may waive the right turn deceleration lane requirement.

7.6.3 Access Drive Storage Space

On-site geometrics are especially critical at drive-through facilities such as banks, fast-food restaurants and car washes. Sufficient stacking space should be provided to prevent blockage of arterial street access and egress. Where information about peak arrival rates and service times is not available, the preferred storage length in advance of a menu board or service bay is 150 feet (100 feet minimum).

Along an access drive from which left turns may be made onto an arterial street, cross-aisles must be located at least 80 from the arterial street (right-of-way line to nearest edge of driveway). A larger setback may be required where traffic impact studies indicate greater than a five-percent probability of driveway blockage during the peak hour of a typical weekday.



- * - Corner clearance may be reduced to a minimum of 100' on approach to an intersection with no potential for traffic signal installation for minor driveways restricted to right turn movements only.
- ** - Corner clearance should be increased to a minimum of 250' where driveway traffic volume warrants a right turn lane on departure from intersection.

FIGURE 12 - DRIVEWAY SPACING ALONG ARTERIAL AND COLLECTOR STREETS